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ABSTRACT

This resource book is one of a series of three information resources containing ideas about instructional technology applications and how certain technology applications may have particular relevance to vocational education. It is designed to help vocational educators make decisions about which technologies to use in their instructional settings. The handbook contains four chapters, each of which focuses on a different dimension of planning. Chapter 1 provides an inventory of planning issues relevant to instructional technologies and an overview of the Illinois education for employment initiative. Chapter 2 contains an overview of media selection models. Curriculum integration issues are addressed in chapter 3. Chapter 4 contains thoughts related to staff development for instructional technologies. The handbook contains 130 references. (KC)

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Illinois State Board of Education

Adult Vocational and Technical Education

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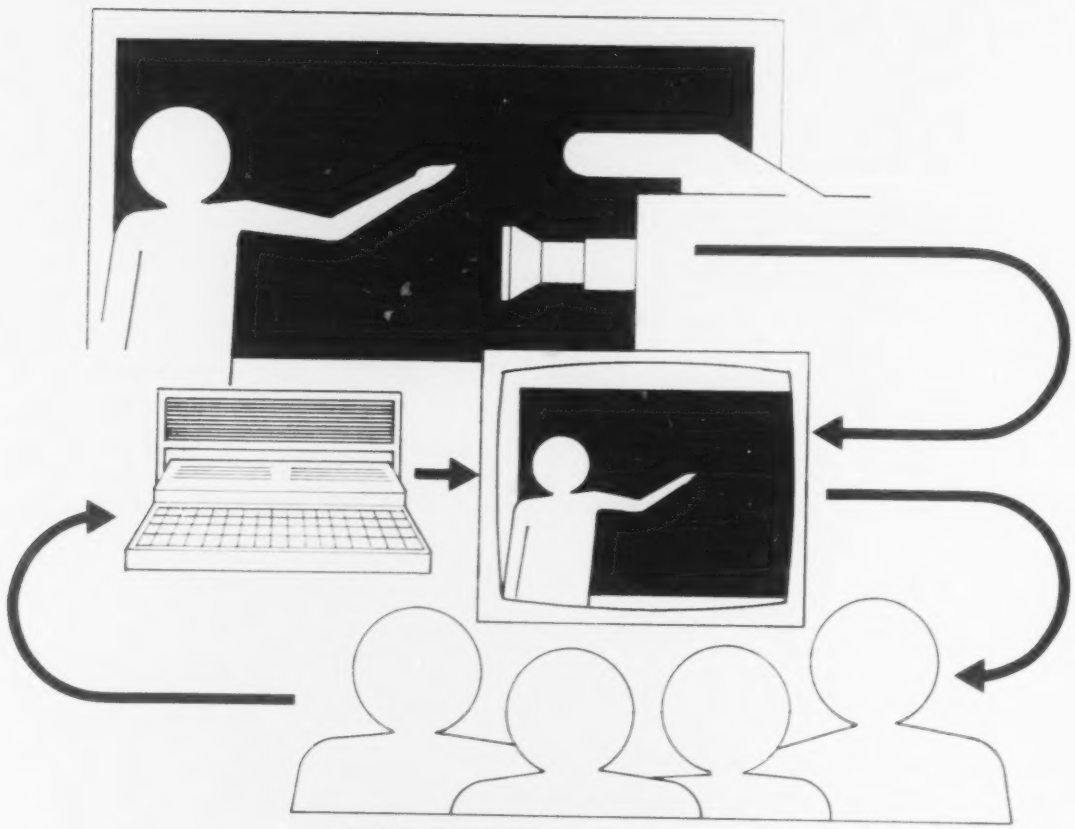

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Instructional Technology Applications in Vocational Education: A Handbook for Planning

Illinois State Board of Education

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Department of Adult, Vocational and Technical Education

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CHAPTER 1

Planning for Instructional Technology Applications in Education for Employment

Introduction

It seems hardly a day goes by when something doesn't appear in the media regarding new technological developments. Newspaper headlines might state, "Man trailing machines in high–tech race," or magazines might feature articles on superconductor research or the latest developments with ceramic engines. Technology, whether it is welcome or not, continues to intrude into the public and private domains of our lives.

The intrusion is forcing us to alter the way we view such things as work, play and learning. Technology is changing the way we gather, analyze and synthesize information for decision making. Technology has the capability of changing our perspectives of viewing and solving problems. One may even speculate that technology will change the way we think.

School teachers and administrators are accustomed to invasions of instructional technologies into their classrooms. For several decades various technological innovations have been touted at one time or another as solutions to instructional problems. School administrators and teachers have purchased various pieces of hardware and software; quite often the devices and materials were tried, tested and forgotten. However, some technologies have worked quite well in the classroom. Overhead projectors, for example, migrated from bowling alleys to classrooms about 30 years ago and are still widely used by teachers.

In light of technological successes and failures in schools, how is technology selected for classroom use? That is, how do educators arrive at decisions for selecting instructional media? How should they? These and similar questions get at the heart of a most important aspect of integrating information technologies into curriculum and instruction: technology **planning**. After two years of research, the authors of this document are convinced that **planning** for the application of information technologies in curriculum and instruction is a most vital element for the successful implementation of technologies in schools. What comprises a good planning effort for instructional technology? Are there examples of good planning? The authors have tried to extract from available literature factors, issues, and concerns about technology planning, and **examples** of

planning that may help vocational educators think through decisions regarding uses of technology in their classrooms.

This document contains four chapters, each of which focuses on a different dimension of planning. Chapter 1 provides readers with an inventory of planning issues relevant to information technologies. Chapter 2 contains an overview of media selection models. Curriculum integration issues are addressed in Chapter 3. Chapter 4 contains thoughts related to staff development for information technologies. Collectively, the chapters are intended to acquaint readers with the importance of planning for the roles of information technologies in schools prior to purchasing or rejecting such technologies. While there is no single formula or process for technology planning, there are some factors that appear to be critical to most planning approaches. We have attempted to highlight some of these factors.

We begin Chapter 1 with an overview of the Illinois education for employment initiative, the context within which information technologies for vocational education must be considered.

The Education for Employment Context

The education for employment (EFE) initiative in Illinois has been the springboard for a flurry of activities related to vocational education. More change has occurred in vocational education in Illinois in the past four years than occurred in the preceding 15 years. The Illinois State Board of Education's new policy for education for employment requested local vocational educators to take a new look at the way they planned, delivered, and evaluated vocational education programs. As a starting point, the State Board asked local educators to offer programs based on a thorough analysis of labor market information. No longer was it acceptable to offer vocational education programs merely because a facility existed or an instructor was available to teach a course. Other types of data were obtained to help local educators revamp vocational programs. For example, the State Board of Education surveyed the career interests of 160,000 sophomore students across the state. This data provided a snap–shot of student interests that was used for planning vocational education programs. An outcome of the research and planning that occurred with the education for employment initiative was the formation of 61 regional providers of vocational education. Local educational agencies will no longer deliver vocational education as lone entities. In the spirit of collaboration, local schools have formed working arrangements with community colleges and area vocational centers to become regional providers of education for employment.

This well–orchestrated plan for renovating vocational education includes updating curricula. A major effort is underway in the state to revitalize curricula based on worker verified task lists. These task lists, representing numerous occupational areas, were distributed by the State Board of Education to the 61 education for employment systems. Each EFE system enlisted support from incumbent workers to locally verify the task lists. These verified task lists will serve as the foundation for curriculum content in vocational education. Another part of the EFE initiative involves examining how the revitalized curricula are to be made available to learners in Illinois—an examination requiring investigation of the uses of technology in instruction.

Instructional Technologies and the Goals of Education for Employment

Access, efficiency and quality: how might interactive video, powerful microcomputers, telecommunications and other instructional technologies be applied to serve these goals? Information technologies have the potential to contribute to all three of these goals of education for employment, but that potential has yet to be realized. Many of these new technologies are yet to be accepted, purchased, and implemented in ways that actively help education for employment systems meet the goals of access, quality and efficiency. System directors are seeking ways that instructional technologies can help education for employment systems achieve their goals, recognizing that information technologies may serve these goals well in some instances, but may open up new concerns for education for employment systems in other ways. On a system–wide basis, new

instructional technologies may create more questions than answers for planners exploring ways to integrate new technologies into their education for employment school programs (Gillespie, Johnsen, & Witherspoon, 1987).

A fundamental issue is how to use these information technologies to actually improve teaching, learning and educational opportunities within education for employment without creating other problems.

Change does not come easily for schools in general, or for EFE programs specifically. There are a variety of barriers to change, such as satisfaction with the existing EFE systems, the feeling that things should not be changed because they have always been done that way, the fear of failure in trying something new, reluctance to expend human, financial and time resources to accomplish change. In light of these barriers, EFE system directors may need to confront the following types of questions as they consider instructional technology applications (Goldstein & Woolsay, 1987):

1. How can educational leaders and planners stimulate an environment full of innovative thoughts and dreams, given the constraints of the economic realities facing education for employment?
2. How can the desire for new information technologies be balanced with the demand for skilled personnel who are needed to manage and operate existing as well as projected information technologies?
3. How can turf issues within an EFE system be overcome in a fashion which maximizes the boundary crossing abilities of new information technologies?
4. How can the capital and operating costs required by information technologies be financed so that existing instructional public service and support systems within an EFE system may still be maintained?
5. How can students be assured equitable access to these new information technologies?

Technology application in classrooms is a means and not an end. Information technologies provide avenues for solving instructional problems. A fundamental issue is how to use these information technologies to actually improve teaching, learning and educational opportunities within education for employment without creating other problems. The tendency is that instructional decision making tends to move farther away from classroom teachers as more complex and expensive technologies and courseware are implemented in schools (Callan, 1987). Such distancing may prove counterproductive in the long run. Well structured experimental programs are needed that encourage local educational agencies and faculty members to innovate with new instructional technologies. Those programs are unlikely to emerge unless plans for instructional technology applications are developed.

The Need for Instructional Technology Plans

Most local educational agencies have made minimal progress toward making education responsive to an information society. Consortias of schools, such as education for employment systems, have similarly accomplished minimal strategic planning. A few bright spots across the country do exist that exemplify long–range planning by schools for information technologies in education (Moursund, 1987). Representatives of such schools recognize these technologies as major change agents and that schools must be ready to respond to needed changes. These planners have carefully considered where their districts stand with respect to information technologies and where they need to be in the future. A problem confronting Illinois' education for employment systems is that most of these regional providers of vocational education are not staffed with experts on long–range planning. System directors may not believe they have the time, resources or abilities to adequately undertake this monumental task.

Long–range plans for education for employment should include visionary goals. What should our schools be like in the best of all possible worlds, and what roles might information technologies play in such schools? Should EFE curriculum and instruction be highly individualized? Will teachers have more time to work one–on–one or in small groups with learners? Will there be more opportunities for teachers to learn, grow and experiment? Will our

classrooms be a more successful and rewarding experience for both students and teachers (Moursund, 1987)?

"What educational problems are being addressed by this technology, and in what ways might technology make instruction better? Is this resource being effectively used?"

If information technologies are to be used in EFE systems, one must ask the questions, "What educational problems are being addressed by this technology, and in what ways might technology make instruction better? Is this resource being effectively used?" A technology planner may make tremendous contributions by seeking answers to these types of questions. As an unfortunate comparison, there are too many cases across this country where school districts are making temporary use of computer coordinators. Districts are not making long–term commitments to such positions. Computer coordinators and, on a broader basis, technology coordinators, should be appointed to develop and periodically direct the long–range plan for information technologies within education for employment systems (Moursund, 1987).

A Lesson from the Private Sector

Perhaps the best evidence that supports the need for a long–range plan for information technologies in education for employment systems is provided by experience in the private sector. Educators are not alone when they experience difficulty planning for information technologies. A report by Business Week (October 12, 1987) stated that office automation efforts usually fail unless they are accompanied by close attention to human factors. There is ample evidence to support this claim. White–collar productivity has remained flat from 1970 to 1986 in spite of a 20% increase in high–tech spending. It sometimes appears that organizations approach technology purchases with nothing more than a blank purchase order and a blind faith in the ability of technology by itself to improve the operations of the business. An imposing difficulty stems from considering automation merely as a way to expedite the existing processes (cited in "Office Automation," 1988). Education for employment leaders will encounter similar difficulties if they blindly procure information technologies without thoroughly considering the intended applications in curriculum and instruction.

Experts cited in the Business Week article urged planners to take a broader view. They stated that companies planning for office automation should consider how new technologies may change the very nature of work. The special report detailed five steps that can make office automation pay off. These steps have ample meaning for education for employment planners seeking to purchase information technologies for schools.

Plan ahead

Most companies automate operations in order to achieve greater productivity. In order to do that, a firm must change how people work as opposed to merely the speed at which they work. In a similar fashion, information technologies may change the work responsibilities of teachers and provide options for improving the fit of curriculum content, learning activities and student learning styles.

Be selective

Across–the–board applications of a new technology are seldom successful. Job analysts should be used to identify those types of workers who are most likely to benefit from office automation. Likewise, system directors should consider which vocational teachers might be most receptive to experimenting with information technologies.

Be patient

Creating an automated environment takes time. The transition period may easily take two or more years. Similarly, transitional periods with information technologies in curriculum and instruction will not achieve over–night success. Several years of experimentation may be needed before an EFE system can brag about its accomplishments with information technologies.

Measure the benefits

Changes are not always beneficial. After the information technology system has been set up, try to determine how workers' jobs have changed and what seems to be working. As a matter of comparison, this approach is needed in schools to learn what benefits were accrued by students and teachers.

Communicate

Although a well–executed, automated office may be created from the top down, it is the employees on the lower rungs who need to learn the system. Their help and support will pave the way for a successfully automated environment. Employees may provide suggestions for the best way to install new applications and revise existing ones ("Office Automation," 1988). A similar communication network must be established between the EFE system director and teachers. Teachers and students must feel a significant ownership of the new delivery methods that are being tested with information technologies.

We have stressed the need for developing an instructional technology plan for education for employment. That idea sounds good in theory, but what goes into such a plan? What human and fiscal resources must be expended to create such a plan? And most importantly, what are the issues for an EFE instructional technology plan?

Issues to be Addressed in an Instructional Technology Application Plan

Without system–wide plans for integrating information technologies into education for employment, the potential for inefficient duplication, mismanagement and failure to solve instructional problems is greatly increased. Many factors affect the composition of a technology plan. For example, a rural school district will have different instructional problems and may need applications of different technologies as compared to suburban or urban school districts. Rural districts may see the advantages of using satellite or videotape systems, whereas urban districts may see advantages in cable or broadcast technologies. Technology plans and policies for education for employment systems should address four issues (Dively, 1987).

Inefficient applications for information technologies will result if they are purchased and applied in ways that do not match their capabilities with instructional problems that exist or are expected for the EFE system.

Needs Assessment

Information technology should not be purchased and implemented on a large scale until the educational needs and instructional problems of the EFE system are fully investigated. Inefficient applications for information technologies will result if they are purchased and applied in ways that do not match their capabilities with instructional problems that exist or are expected for the EFE system. The EFE system should identify existing instructional problems (needs) as well as future educational needs. Major concerns such as improving the quality of programs, increasing the efficiency of programs, or opening programs to greater access for students are all relevant issues for an information technology plan. Information technologies should be reviewed in light of these needs so that educational planners may evaluate each technology and according to unique strengths and weaknesses.

Goals

A regional EFE technology plan should include a list of goals when they pertain to the instructional and support needs identified in the needs assessment. Timetables for creating and activating programs should accompany each goal.

Roles and Missions

Each EFE system should have roles and missions identified for its future. These statements may need to be revised in light of capabilities of information technologies. Mission statements that pertain to information technologies should be adaptive and reflect the changing nature of developments for the future.

Access and Equity

Information technologies should create opportunities for increasing access for clients of vocational education. However, new problems associated with access may be amplified that pertain to social or economic factors. The EFE technology plan should address approaches for enhancing access to information technologies for all types of learners.

The formation of 61 education for employment systems in Illinois is a new experiment. The EFE initiative has caused local vocational educators to create new paths that might lead to curriculum renovation, instructional improvement and professional development of personnel. The EFE journey is incomplete; local educational agencies are still charting new approaches for making this experiment in school collaboration a successful one.

As schools work together to improve vocational education, their planning for applications of instructional technologies need not begin from a "zero base" of planning data. Much information is available regarding how other schools have experimented with instructional technologies. For example, the purchase and use of microcomputers in schools is fairly well chronicled; it provides a documented lesson that may benefit instructional technology planners for education for employment.

What We Have Learned from the Microcomputer Revolution

The explosive growth in the number of microcomputers in school districts across the country provides many examples of problems that occur when districts procure equipment without properly planning for its use. Less than 30,000 microcomputers were in America's schools prior to 1981. Over 2,000,000 units are currently housed in schools. Approximately 100% of the schools in this country have at least one microcomputer, yet less than 10% of these school districts are estimated to have comprehensive plans for integrating computers into school curricula. If schools do not have plans for integrating microcomputers into curricula, they probably do not have plans for integrating other information technologies into curricula and instruction.

David Moursund is editor of Computing Teacher, the journal of the International Council for Computers in Education. He has conducted many workshops on long–range planning for instructional technology. He has concluded that most of the planning done by local school officials has been quite superficial. A typical plan is developed under severe time restraints by a small group of people to meet state requirements to obtain funding. The following list of flaws contained in these types of hastily constructed plans provides a cautionary warning for EFE systems in the preliminary stages of planning for information technologies (Moursund, 1987).

1. Inadequate participation and ownership by all the critical stakeholders.

A variety of stakeholders should be involved in the decision process regarding new information technologies. These people may include taxpayers, business and industry representatives, parents, teachers, school administrators, school board members, legislators and, of course, students. The professional lives of these individuals may be altered by the recommendations within the technology plan. These people could prove to be a serious deterrent to the implementation of a technology plan if they believe they were not represented in the planning process. A plan that contains many good features may be destroyed by a few opponents who are not involved in its development.

2. Inadequate consideration of articulation issues.

The content and process of education is affected by what students learn at preceding grade levels. Teachers at higher grade levels must consider the technology, knowledge and skills that students have acquired in earlier grades. Education for employment systems have worked through articulation agreements with secondary schools and community colleges. This type of collaboration is needed to create a technology plan that satisfies the expectations of both types of agencies.

3. Failure to address the testing issue.

The word processing environment provides a good example for this issue. Students may learn process

writing that is supported by spelling and grammar checkers or other aids with their word processors. Eventually, students will have had years of practice writing in this environment. Will they be allowed to use these writing aids during tests? A similar question must be addressed in the area of drafting. What is the appropriate mix of manual versus computer–aided drafting in a drafting program? Which skills should be the predominant content for assessment? Eventually, each vocational discipline will be faced with testing issues that pertain to the "technology way" versus the "old way" for student achievement.

4. Failure to address equity issues.

Students from wealthy communities may have ample access to computers at home. The ratio of computers to students may differ by a factor of 5 from one school to another. Within an EFE region, some students may have an educational advantage if computers are increasingly integrated into curricula.

5. Failure to provide for permanent funding.

The majority of computers in schools have been procured through one–shot funding opportunities. Computer resources have not been integrated into the general budget. Dollars are not available to maintain current computer facilities, much less achieve a level needed to increase these resources to meet student needs (Moursund, 1987). What will happen in the next few years as this equipment becomes outdated, and the one–shot source of funds is no longer available? Education for employment systems would be wise to plan for realistic budget line items for instructional technologies that may be supported with general revenue dollars.

6. Failure to consider changes that may occur as substantial units of study have become available through computer–assisted instruction or other distance education modes.

Over the years, we have seen a gradual long–term trend toward individualization of instruction. Computer–assisted instruction and other types of information technologies may hasten this trend. The growth of opportunities for distance learning may have a major impact on both students and teachers. Education for employment systems that do not stay abreast with distance learning developments may lose their constituents to other academic disciplines or other providers of services.

7. Failure to provide for adequate evaluation.

The use of computers in schools is still experimental. Their use should be accompanied by careful formative evaluation that provides feedback to help us improve future applications. Summative evaluation is needed to assess longer term effects of the use of computers in curriculum and instruction. All applications of information technologies for teaching and learning need thorough evaluation to determine how the results compare to traditional classroom methods.

8. Failure to provide for annual review and update of the plan.

This type of review is needed to examine data gathered from the formative and summative evaluation. Such a review may provide ideas for applications of new technology developments that may be tested within the EFE region.

This sharing of information is probably the single most important resource that can be made available to local leaders for information technologies.

Ideas for Planning: Things That Have Worked

Moursund listed flaws that may result from hastily constructed technology plans. However, positive examples do exist of how schools infused information technologies into curriculum and instruction. Kloosterman, Campbell and Harty (1987) used a case study approach to examine several schools with model computer curricula. A profile of these leading edge programs found that all the case study schools had two or more labs with at least 15 computers per lab. The labs were used for computer classes such as literacy and programming, as well as for subject area or grade level classes. Labs were used a high percentage of the time and schedules were arranged so as to reserve time for certain classes and maintain an optimum level of use for the lab. Port-

able computer units were available for teachers to use in their own classrooms.

A vital component for the success of the schools was that a computer coordinator was assigned to oversee the programs and equipment, provide support to teachers, and schedule computer use. Education for employment systems that are attempting to integrate information technologies into curriculum and instruction should give strong consideration to assigning a person responsible for that charge (Kloosterman, Campbell, & Harty, 1987). Computer coordinators have played important roles at schools that have successfully integrated computers into curriculum and instruction. Information technology coordinators may play similar roles for education for employment systems.

An Arkansas study has shown that state departments of education and state legislators can do a great deal to help local educational agencies develop organized plans for integrating information technologies into curriculum and instruction. In 1983, the Arkansas legislature established a commission on microcomputer instruction that was proposed to help the state's department of education determine cost effective ways to utilize microcomputers in schools ("Arkansas Study," 1987).

Their goal was and continues to be the improvement of teaching basic skills in mathematics, reading and language arts in the elementary schools. Through a program called IMPAC (Instructional Microcomputer Project for Arkansas Classrooms), the purchase, installation and repair of all hardware, selection and purchase of all software, inservice training, demonstrations, and evaluation are supervised on a state–wide basis. IMPAC has used pre and posttesting research efforts to determine which programs were most successful, the optimum ratio of regular instruction to computer– assisted instruction, and the maintenance costs associated with the more than 2,600 computers that were used in the project. At the beginning of fiscal year 1988, there were over 100 schools, 800 teachers, and 15,000 students involved. This state–wide strategy for determining the cost and learning effectiveness of computers in Arkansas schools seems to be having a very positive impact. A similar strategic approach could be used to improve the teaching of vocational skills via information technologies in Illinois.

On a smaller scale, Stone (1987) found that for people who are breaking new ground in integrating information technologies into school systems, perhaps the most important thing for success is their interaction with other individuals who face the same challenges. These local innovators need a forum for sharing ideas, problems, concerns, issues and dreams for the future. An example of this type of forum is the Atlanta Area Computer Educators' Group that consists of more than 75 local educators from private and public schools. It is a group of computer coordinators who gather to share tips on motivating teachers, discussing new software finds, sharing ideas for organizing software and hardware, and discussing strategies for surviving in the tough job of computer coordinator. This sharing of information is probably the single most important resource that can be made available to local leaders for information technologies (Stone, 1987). A similar type of forum could be established for information technology coordinators of the 61 education for employment systems.

Much can be learned about integrating information technologies into a school district by examining the approach taken by the Houston Independent School District (HISD). Patricia Sturdivant, Associate Superintendent of Technology for the district, leads one of the country's largest and most well organized computer programs in a multi–ethnic, multi–racial district of 233 schools. Sturdivant (cited in Reinhold, 1986) believes that every district needs a strong administrator. Ideally, this would be someone experienced in both administration and technology who can articulate a mission for the district and communicate plans effectively to those involved with computer education. The Houston Independent School District was the first to form a Department of Technology at a district level. It has grown from three people to over 100 as it works to help district personnel with volume purchases of hardware and software. The job of the Department of Technology has been to address problems of disadvantaged students and to move all schools into the information age. The intent is to have all students benefit from technology that is integrated into regular teaching and learning practices.

The Houston Independent School District has a well developed plan for training teachers to become technologists. Their intent is to redefine the teacher's role from that of lecturer, who merely conveys information, to one of manager. A teacher technologist program is used to select and train teachers

in a 296 hour inservice and self–study course. Teachers earn salary bonuses for upgrading their skills with the technologist training. In addition, these trained technologists are able to move into leadership positions in their schools. They then have responsibilities for training other teachers and administrators to use information technologies. The district estimates that approximately 5,500 teachers and administrators have received training from the Department of Technology (Reinhold, 1986). A total district commitment to this concept has helped make this a model program.

Underlying the Plan: A Philosophy of Instructional Technology

To some educators, the word philosophy elicits fear and trepidation. They may experience flashbacks to an undergraduate liberal arts course in which heated discussions took place among a few enlightened debaters while the rest of the class eyed the slow moving clock on the wall. Those types of discussions may have been appropriate for Philosophy 101, but most working adults do not seem willing to put time and energy into debating the foundations of truth.

Philosophy, as we are using the term here, is a very important segment of an instructional technology plan for education for employment. Philosophy is the set of beliefs and values that will guide educators' actions with instructional technologies. These beliefs are entwined with issues such as curriculum, staff development, instructional strategies and cost effectiveness. Key stakeholders of an education for employment system must find a common ground on the various issues on which technologies will impact. This common ground will be the philosophical foundation for the instructional technology plan.

Education for employment system directors are gaining a wealth of planning experience on a regional basis. Quality assistance plans, building fairness and opportunity plans, and articulation agreements are being created on a regional basis with input from participating local educational agencies. This same type of effort is needed to create system–wide information technology plans for education for employment. Vocational educators can learn from the experiences of school districts that have experimented with computers. Some identifiable beliefs have evolved from these experiences. The following perspectives may help system directors structure a philosophical basis for an EFE instructional technology plan (Dively, 1987).

1. Technology is a means, not an end.

As we have learned from the microcomputer revolution, educators sometimes procure technologies because of their newness or trendiness as depicted in newspapers or on television. Little thought is given to how these purchases might help solve instructional problems. Because of this approach, the new technologies are either misused or not used at all. Vocational educators will benefit if they first identify instructional problems facing vocational education and then examine how applications of instructional technologies might meet those needs.

2. Technology requires re–evaluation of roles, missions and service areas.

Information technologies may be used to deliver programs of instruction at a great distance from the home school setting. These technologies will permit education for employment systems to reach new populations at a variety of locations at any time of the day. With this type of opportunity for creating greater access to education for employment, schools within a vocational education region will need to rethink their mission and service responsibilities and how information technologies might be used to broaden the purposes of those agencies.

3. Different situations require different technologies.

Education for employment technology planners will face an ongoing challenge to stay abreast with new developments in information technologies. Applications of these new technologies will continue to expand, perhaps exponentially, and certainly unabatedly, for several decades. Each technology has strengths and weaknesses for solving various educational problems. In some cases, a mix of technologies may be best suited for serving instructional problems. System directors and other key vocational educators within EFE systems will need to

develop expertise at matching technology applications to the appropriate instructional problem that exists within their region (Dively, 1987).

4. Technology changes rapidly.

Anyone remotely aware of the growth of the computer industry in the last ten years knows that the speed, power and application of microcomputers have increased tremendously. This type of advancement of microcomputers, as well as other technologies such as fiber optics, video, compact disks, and other advancements, will continue to improve the capabilities of informational technologies toward meeting educational needs. Those who plan to implement instructional technologies in EFE must be keenly aware of the changing nature of these educational tools. Periodic reviews and revisions for technology policies in EFE will be needed so that new information technologies may be tried and tested in vocational education programs.

5. New technologies are not always the best.

Information technologies that are the "hot items" on the market are not always the most appropriate for solving the instructional problems of a particular school, district, or region. Sometimes instructional technologies and methods that have existed for a few years are more reliable, less expensive, and more easily understood by instructors. System directors or technology planners must be able to recognize the strengths and weaknesses of both old and new technologies so that advantages and disadvantages may be weighed before educational tools are selected for an instructional problem.

6. Instruction, not technology, is the largest factor affecting program quality.

The main ingredient of a successful instructional program is the quality of the courses. The technologies that accompany that instruction are important only because they may insure clear access to the program at appropriate times and places (Dively, 1987). Vocational education must be systematically developed, delivered and evaluated with substantial input from incumbent workers who can verify curriculum content.

7. Teacher involvement is critical for success.

There are teachers who simply do not feel comfortable experimenting with new instructional technologies. Some feel that technology disrupts the way they teach their courses, others believe it increases their workload, and still others see it as a threat to their job security. If vocational education teachers do not accept the role of information technologies in education for employment, they may dramatically reduce the effectiveness of these information technologies. Education for employment system directors should look to vocational teachers as partners in planning, implementing, and evaluating a plan for integrating instructional technologies on a system–wide basis.

The preceding issues may be merely a starting point for discussing technology related concerns for EFE systems. Other concerns may surface as a result of unique characteristics of the schools that comprise an EFE region.

Some Additional Planning Considerations

Technology and the Goals of EFE

If planning was a simple process, more people would do it. Unfortunately, it is a difficult and abstract process that does not follow a universally accepted set of procedures. Vocational educators should not get so caught up in the process that they forget the foundations which should be guiding their actions. As was stated earlier in this chapter, the central thrusts of the EFE initiative are to improve the quality, enhance the effectiveness and increase access to vocational education. Although instructional technologies may be used to reach these lofty goals, the capabilities of some technologies may create additional concerns for vocational education planners.

Access

Policies may be needed on a regional basis that encourage the use of information technologies with underserved clienteles such as learners in rural areas or special needs learners. Demographic characteristics within a region may result in wealthy and poor schools both trying to implement the same vocational curriculum, but with radically different tools. Students from poorer districts, for example, may not receive opportunities to learn with new technologies

because their school cannot afford the technologies. System directors must help guard against a situation where students are denied access to technologies because of age, race, sex or handicapping conditions.

Efficiency

What policies will be needed within an EFE system that will encourage innovative approaches to instruction and at the same time support collaboration among participating school districts? Information technologies should be used to enhance the revitalized curriculum that is currently under development within EFE regions throughout the state. These technologies should be used to increase achievement of students and maximize learning efficiency.

Universities are supposedly incubators for research and innovation, yet there does not seem to be sufficient interest on campuses to use information technologies to creatively solve instructional needs.

Quality

New information technologies should play an important part in the future of vocational education curriculum and instruction. Pursuit of excellence should be a primary purpose for using information technologies. Questions will arise regarding the traditional roles of vocational instructors, how those roles should be preserved and how they may be changed by alternative modes of delivery based on new technologies. The ultimate goal in using information technologies is to impact student behaviors. Their use within revitalized EFE curriculum must better prepare students for entry level employment or for attaining advanced educational goals.

Elementary and secondary schools still seem unprepared to accept opportunities that are available through new information technologies, but they are not alone in this matter. For example, universities appear to be most interested in telecommunications for the purposes of data exchange and research (Mingle, 1987). Universities are supposedly incubators for research and innovation, yet there does not seem to be sufficient interest on campuses to use information technologies to creatively solve instructional needs. Students are still gathered in traditional classroom groupings and lecture halls to receive instruction.

One reason change is difficult to attain in public schools is because costs incurred in the past are not easily liquidated .

There are also barriers restricting the use of instructional technologies in secondary vocational education programs. Education for employment systems contain traditional patterns of instruction that must be laid aside so that experiments with alternative methods for delivering vocational education may be conducted. Funding formulas, class schedules, carnegie units and a host of other restrictions may be used as excuses by vocational educators for foregoing experiments with new instructional technologies.

Start–up costs for information technologies may also be a considerable restrictive barrier. School districts that have joined together to form education for employment systems understand the difficult nature of discarding current assets in the hope of gaining a greater degree of instructional efficiency. One reason change is difficult to attain in public schools is because costs incurred in the past are not easily liquidated (Mingle, 1987). Schools have expended considerable human and fiscal resources to put current curricula in place. These costs may include land, buildings, equipment, laboratories and employees with job security rights that are closely connected to a popular type of program. What if instruction based on new information technologies makes these past expenditures appear unjustified? Are schools willing to make that move at the risk of constituent criticism? When schools resist planning for new instructional technologies they run the risk of becoming out of touch with public and private institutions that are on the forefront of the information age.

EFE System Directors: Essential in Instructional Technology Planning

It's fairly easy for the authors of this document to advocate the use of new information technologies as a means for improving education. Such advice has occurred with regard to each new instructional technology that has hit the streets for the last 50 years. Likewise, education for employment system directors may easily advocate new instructional technologies to teachers. However, actually creating and implementing a system–wide strategy that provides students with optimal access to information technologies and quality courseware is a considerable challenge (Trainor, 1987).

Unfortunately, a sufficient research base does not exist that guarantees new information technologies will promote better student learning, increase interactions between students and teachers, or improve instructional effectiveness. Information technologies are tools to help EFE instructors meet instructional needs of students. However, achieving effectiveness with instructional technologies is a burden instructors must solely bear. Vocational instructors set goals, develop procedures, and determine the effectiveness of information technologies at meeting the educational needs of their students (Trainor, 1987). System directors may provide support in this great challenge. In some cases, EFE instructors may be faced with inadequate equipment, information technology products that are unproven to be effective in the classroom, and ignorance about new advances in information technologies. A host of problems may await teachers and administrators who are beginning experiments with information technologies. Guidelines for implementation are needed. Clearly, each EFE system may benefit from a well conceived plan for technology integration in education for employment.

Commitment from key educational leaders is vitally important to integrating information technologies into EFE curriculum and instruction. At center stage on this issue is the **system director** for education for employment. The system director can strongly influence the degree to which instructional technologies are integrated into curriculum and instruction. The more this individual is involved with technology issues, the more probable that a commitment will be made to investigate instructional technologies as a means for improving the quality vocational education. What factors might lure system directors to support experiments with information technologies? There are several dimensions of commitment that system directors may possess that stem from a variety of factors (Gery, 1987).

Not Satisfied With The Status Quo

System directors who believe that instructors are satisfied with current curriculum and instruction will not be anxious to campaign for drastic changes. System directors might think... "Even though our situation is not perfect, instructors seem fairly satisfied with what we have. Why rock the boat?" The system directors must recognize information technologies as avenues for reaching curriculum and instructional goals that are central to the EFE initiative.

A Vision For Desired Outcomes By Using Information Technologies

System directors who have a **clear vision** of what might be accomplished with information technologies are more driven to overcome barriers that confront their use. What are unsatisfactory conditions of the present situation? Highlighting undesirable conditions may build a mood for change that will help a system director encourage others to examine new instructional technologies.

The Critical Need For Change

Information technologies should be considered important components for meeting instructional needs. Instructional technologies should not be viewed as "desirable" peripherals that are not integral to solving the instructional problems of EFE. They should be identified as priorities in curriculum planning strategies outlined by the system director and accepted by the system board of control.

The Required Resources For Information Technologies

System directors are in a position to guide the direction of resources that may enhance the success of projects. By working with local administrators, system directors may recommend expenditures of fiscal and human resources needed to create change with new information technologies (Gery, 1987). Sources of expenditures may be quality assistance plans, building fairness and/or opportunity funds, and equipment funds.

Impact On Education For Employment Curriculum

How well do system directors understand the applications of information technologies in the curriculum and instruction for vocational education? How well do they understand the relationship among media selection, curriculum and instruction, and learning? These questions suggest that system directors may need professional development prior to assuming a role in integrating instructional technologies into EFE systems.

The Impact Of Human Change

To what extent do system directors appreciate the degree of change that teachers make in their day–to–day teaching assignments? How willing are vocational instructors to accept new technologies in their classrooms? System directors would be wise to adopt a leadership style of "managing by walking around." This style has proven successful for corporations such as Hewlett–Packard, Marriott Hotels, United Airlines and Wal–Mart stores. System directors need to visit classrooms and talk to teachers to gauge their receptiveness to applications of new information technologies in their classrooms.

Public Promotion Of Information Technologies

To what degree are system directors willing to publicly support the integration of information technologies into EFE curriculum and instruction? Are they willing to promote these concepts to their boards of control, to their funding sources, to teachers, to local administrators and to others? The system director must portray an organizational commitment to using information technologies in all of the schools within the system (Gery, 1987).

Evaluating Process And Products

Is the system director willing to create and implement an evaluative measure that may be used to judge the progress of integrating information technologies into EFE? Evaluation of vocational education should be conducted on a regional basis according to state recommended guidelines. Within these guidelines, the system director should ascertain the effectiveness of information technologies compared to traditional patterns of teaching.

A Task Force for Technology Planning

The issues are complex. Perhaps the only thing certain is that careful educational planning is vital for integrating information technologies into EFE. No one person can mastermind this type of change in curriculum and instruction. System directors can benefit from creating a task force to carefully examine the issues. Objectives for such a taskforce might include the following (Mills, 1987):

1. Develop and maintain an information technology profile of the EFE system. The profile may include an inventory of existing and planned facilities, electronic equipment and networks, trained personnel, as well as current applications of instructional technologies and what are viewed as barriers and/or opportunities for infusing information technologies into EFE;
2. Enhance awareness levels of administrators and teachers regarding new information technologies and their potential applications in EFE;
3. Take a systematic approach to gathering and disseminating information about equipment, software, and peripherals;
4. Consider EFE system policy implications that may emerge from the integration of information technologies into existing or projected curriculum and instruction;
5. Plan, develop and implement information and resource sharing, training and other types of activities in response to identified needs.

Planners should seek opportunities to collaboratively use information technologies among local educational agencies within the EFE system or at state levels. Information should be shared with teachers and administrators throughout the EFE system regarding how information technologies may improve the quality of worklife among the teaching ranks. Clearly, new procedures will be needed by EFE system directors and task force planners for setting priorities, making decisions and identifying new means of financing the more frequent and costly acquisitions of information technologies. Factors unique to these new information technologies pose the following types of problems and issues (Goldstein & Woolsay, 1987):

1. The array of technically feasible options is increasing each year with the wide range of capabilities and price tags. For example, no longer do we have the single option of a wired system to provide voice and data transmission. Technologies such as fiber optics, microwave and satellite systems increase the options for telecommunications.

2. Because technological change occurs at such a rapid pace, it is difficult for planners to determine the best time to purchase desired technologies. With the cumbersome nature of the procurement processes at local institutions and community colleges, planners may very well change their minds from the time their decisions are first specified until the time technology system selected arrives on site.

3. The axiom that cost will rise over time is not necessarily the case with information technologies. The cost per computing power has decreased over the past 20 years and that trend is expected to continue in the future.

4. Conversely, there are costs involved with major systems such as full equipment video facilities. These enormous costs may compel local educational agencies to work cooperatively with universities and community colleges on a regional or statewide basis to finance and operate large scale information technologies.

5. The nature of telecommunications systems runs counter to the concept of a self–contained campus or school system. Information technologies provide the ability to link school systems to work places and homes and provide ways for expanding the teaching and learning process in a variety of ways. Schools may not be ready for such translucent classrooms.

Summary

The dimensions of planning for instructional technologies in education for employment are varied. Clearly, planning should not be viewed as a single activity. Planners face the challenge of aligning applications of instructional technologies with the EFE goals of access, quality and efficiency. In this chapter, the authors have stressed the need for instructional technology plans, outlined the major components for such plans, and suggested ideas that might guide the development of them.

The following chapters will permit you to consider other major concerns that are related to instructional technology planning. Chapter 2 contains an overview of media selection models. These media selection models feature varied approaches for selecting instructional technologies for educational uses. Curriculum integration issues are addressed in Chapter 3. Chapter 4 is a collection of thoughts concerning staff development and the integration of instructional technologies in education for employment. Collectively, the themes of these chapters may be used to forge the developmental stages of an instructional technology plan for education for employment.

CHAPTER 2

Selecting Instructional Technologies

Introduction

In Chapter 1, a number of factors that influence the development of a technology plan were described. While each plan should reflect the uniqueness of the setting for which it is intended, there is at least one component that is common across all plans: the need to select particular technologies for use.

The process of selecting the technologies to be used in a given setting has often been called the **media selection** process. Numerous researchers and writers have developed processes or models to guide decision makers in selecting technologies for use. In this chapter, the work of some of these writers is shared. Our inventory of **models** is not complete, but is, representative of the literature on the topic. More detail is provided for the model developed by Rieser and Gagne.

Anyone who has attempted to select media for instructional purposes understands it is not a simple task. Many variables enter into the decision making process. The choices can be especially complex for education for employment systems whose schools represent a broad range of demographic factors, educational goals and instructional needs. The following types of questions provide examples of how different factors complicate the matter (Anderson, 1983):

1. To what degree must the education for employment programs simulate the real working conditions of local employers?
2. What instructional technologies seem to be most logical for packaging, implementing and updating the education for employment programs?
3. What types of equipment will be needed to supplement the medium that you have selected?
4. Will the instructional technologies that you have chosen match well with learning needs of the students and worker verified tasks?
5. Are costs of instructional technologies used for a course justifiable according to expected course outcomes?

Individuals responsible for planning the integration of instructional technologies into education for employment programs will experience greater success if they make a few assumptions about the process of planning media selection (Anderson,1983).

1. It would be wise if system directors educate key personnel about the place that instructional technology plays in the entire education for employment process. Media selection should be viewed as an im-

portant part of this total process. Once worker task lists have been verified within education for employment systems, media decisions should be viewed as a part of the curriculum development process and instructional technologies should be viewed as tools for increasing the effectiveness of teaching certain types of content.

2. System directors, and hopefully a taskforce on instructional technology for the education for employment system, should view the selection of efficient and effective media for instruction as a means of balancing lesson content with the features and characteristics of specific media.

3. Within the education for employment system, decision makers must realize that compromises will have to be made. The purpose of using a taskforce on instructional technology and for using a systematic selection process is to make sure that decisions are not based on whim, convenience or political expediency, but instead are made upon a careful analysis of program content and design.

Consider this perspective on media selection*:

Chef Pierre and Chef Andre are both responsible for preparing a dessert for tonight's meal. Chef Pierre looks at the dinner menu, noting today's special. After analyzing the nutritional value of various desserts and consulting his taste charts, he announces that the best accompaniment would be a banana tort. Chef Andre, meanwhile, has gone to the kitchen. The produce truck has been delayed, and the only fresh fruit available is bananas. Andre reflects on the taste preferences of tonight's regular customers, and decides that rather than banana compote or banana pudding, he will make banana tort.

Media Selection Models

The processes used by the two chefs in selecting their desserts illustrate two divergent points on a continuum of media selection models. This continuum may seem confusing to vocational educators who are pondering approaches for selecting media. Like Chef Pierre, many models begin by assuming that there is an ideal (or best) medium or media to accomplish the designer or teacher's objective (see for example, Smeltzer, 1984; Rieser & Gagne, 1983; Wileman & Gambill, 1983; Stein, 1979; Freedman & Gruebel, 1979; Gropper, 1976; Tosti & Ball, 1969). Usually these take the form of steps, a flowchart, or a list of criteria/considerations that will help a vocational teacher reach a media decision. Other models use tables or matrixes of attributes and/or classifications of media, learners, or environments (such as Boucher, Gottleib, & Morganlander, 1973; Levie, 1977; Holden, 1977; Stolovitch, 1977; Ibe-Bassey, 1988; Kemp, 1963; Ihebuzor, 1986; Lowden & Petty, 1981; Berman, 1980; Leiblum, 1980). These allow consideration of various criteria throughout the selection process and tend to be inclusive of various media, rather than eliminating them. These latter models, like Chef Andre, often consider **availability** as an initial or primary decision.

What is intriguing about these divergent approaches is their potential in helping planners achieve instructional goals that have been established for education for employment. Is there a particular media selection model that is more appropriate or effective in designing and delivering, education for employment programs? Are the media selection models used in general instructional design acceptable for education for employment, or are special models needed to accommodate unique characteristics of education for employment? In this section, we review some of the literature on media selection models and assess their value in planning, delivering and evaluating education for employment programs.

Rationale and Reviews

Robert Gagne's oft-quoted conclusion in his 1970 classic The Condition of Learning was that "most instructional functions can be performed by most media" (1970a). Later, he added that:

So far as learning is concerned, the medium

The Chef Pierre scenario and the bulk of material in the next section of the chapter was developed by Monty Winters, a doctoral student in Adult and Continuing Education at Northern Illinois University.

is not the message. No single medium possesses properties which are uniquely adopted to perform one or a combination of instructional functions. Instead they all perform some of these functions well, and some not so well (Gagne, 1970b).

Schramm (1977) did not interpret this to mean we should stop looking "to find the best medium—or at least the **better media** for that task;" rather, he says Gagne is "recognizing the limited usefulness of present research in guiding the selection of media for instruction." Kissock (1985) and Elliot (1986) have noted that, in practice, many designers and practitioners do not use or follow a formal media selection model. But studies by Evans (1986), Higgins and Rieser (1985), and Braby (1973) indicate that designers who **do** use a formal model make "better" choices (choices more similar to those of experts). Therefore, most instructional design models include some method, model, or criteria for selecting media.

In addition to Schramm (1977), two literature reviews of media selection models have been identified. The first of these is a short review of ten models (including his own) by Levie (1977). The review is not a critique of the models, but an attempt to describe the "positive contributions of each model" (Levie, 1977). The second, more recent review is an examination of the **characteristics** of ten media selection models (Rieser & Gagne, 1982). The authors examine the classification schemes and selection features of each model. This second review was later incorporated into the rationale for Rieser & Gagne's model (1983). Three of the models are included in both reviews, and of the seventeen models, five are included in this review.

Model Purposes and Presuppositions

One possible explanation for the variety in models is a difference in purpose:

Some models may be useful in coming to a broad understanding of the media resources you have at your command. Other models may be more helpful in actual decision making. In other cases, a given model may not be appropriate for your own decision making, but may be useful as a device to aid a client or subject matter expert in the analysis and understanding of his problem (Levie, 1977).

Readers should note that these models are intended for media selection, not **materials** selection. That is, they are for use in development of instructional items, not the selection and/or evaluation of those that already exist (Levie, 1977). This is an important distinction, since many references to **media selection** include both types (Sive, 1979; Stein, 1979). It also has crucial significance to the larger instructional design model, since the decision to purchase or produce may not have been made prior to this step.

Regardless of a model's intended or actual use, all of the models presuppose that the learning tasks and/or objectives have been or will be decided prior to selecting the media. Such is the case with vocational education curriculum that is derived from worker verified task lists. The assumption undergirding this approach is that "the content can be held constant independent of the media used to present it; in other words, message and medium are separable entities" (Levie, 1977). Mugridge believes:

Any discussion of the use of educational media from the traditional and still well–used print to the most advanced and sophisticated electronic tools must be based on the assumption that the mix of media should change from course to course as learners and their objectives change (1987).

Interestingly, Levie notes that:

the sequence of defining the learning task prior to media selection is counter to the procedure by which most existing instructional material came into being. For example, the vast majority of our educational films were produced by film makers in search of subject matter appropriate to their medium (1977).

This raises questions for vocational educators as to where in the instructional design process the media selection is made. One difficulty related to this is establishing the unit (course, unit, lesson, objective, etc.) for which to make a media selection. That is, the decision facing the designer may be one of selecting **delivery** systems rather than the instructional media presented by those systems. Rieser and Gagne (1983) defend their practice of selecting media "for either a single objective or a clustered set

of objectives which are part of the same lesson or module, and which belong to the same domain of learning outcomes." The authors argue that:

> *when small segments of instruction are examined, the various media identified as appropriate for individual events or objectives are collectively reviewed. Subsequently chosen is that medium, or combination of media, which appears to be most suited to the largest portion of the lesson or module. Under such a procedure, the value of selecting media for small segments of instruction is likely to be diminished when a final selection decision is made. Given this shortcoming, it appears doubtful that there are substantial advantages to the procedure of choosing media for segments of instruction smaller than those with which our model deals.*

It is at this point that the differences between various models become magnified. One way of understanding these differences is by examining the "size" of the objectives or components of objectives for which each model attempts to select media. Does the model address the **macro** delivery system, or the **micro** single interaction between instructional media and the vocational education student? Further, which of these does it require or encourage to be selected first?

Models

An early model was proposed by Kemp (1971) for selecting audio–visual media using a flowchart. Major decision points included were the audience size (large group, small group, or individual) and the type of experience (verbal abstraction, direct concrete experience, or vicarious sensory experience). He then listed several possible media which could be used. Pett (1980) later presented a seven–step audio–visual model. Like Lowden and Petty's (1981) model, these rely on some scheme of classification of the media.

Gropper (1976) argued for a behavioral, response–oriented model rather than one based on communication theory. His model selects media based on instructional strategies, which in turn are based on the desired performance mode (stimulus, response, or feedback) of the objective. These instructional strategies, or **active carriers** (ex: lectures, programmed instruction, CAI), are delivered through **passive carriers** (film, radio, print, etc.). His four steps are:

1. statement of objectives
2. analysis or classification of objectives
3. formulation of instructional strategies
4. media selection.

Gropper's active/passive distinction is similar but not identical to Holden's (1977) idea of hardware and software. Tosti and Ball (1969) also present a behavioral model, but believe that a distinction should be made between medium and **presentation form**:

> *As an example of the relationship between presentation and media, consider that a picture of an elephant in a book versus a verbal description of an elephant by a teacher differ in both media and presentation form. However, a picture of an elephant on a slide and the one in the book have the same presentation form but are being delivered by two different media. It is also possible for a given medium to be able to deliver several presentation forms. It is doubtful if all presentation forms can be delivered equally well since media have differing limitations.*

The authors are clearly concerned about the micro/macro distinction mentioned earlier. They also propose that media **limitations**, rather than media advantages, be the criteria for selection. They maintain:

> *The difference is subtle but important. Two media may fit the general requirements of the presentation form, but each has different limitations. It may be easier to compensate for the limitations of Medium A than of Medium B. Hence, Medium A should be selected. Quite often, however, Medium B has an aura of advantage surrounding it. It is multisensory, it is new, it has been successfully used in other settings, or it has received great press reviews. The novice designer may, therefore, incorrectly select Medium B because of its intrinsic advantages which are really superficial to the learning task.*

Tosti and Ball also advocate this "media elimination" approach as providing a better base for mixed–media systems.

Boucher, Gottleib, and Morganlander (1973) propose a model based not on steps or a flowchart,

but on a matrix of media requirements and capabilities. Classifying the requirements for presentation, student response, and instructional strategy presented the designer with a table from which a medium meeting most or all of the requirements could be selected. The authors even include a catalog of agencies where delivery hardware can be obtained.

Models using a matrix are also proposed by Levie (1977), Berman (1980), Leiblum (1980), and Bates (1984). Most of these are based on some kind of analysis of media characteristics or attributes. This "media attribute" approach is advocated by Noel and Hewlett (1981), Medsker (1981), Holden (1977) and Levie (1977). Levie's (1977) model begins by examining the task, the learner, and the environment in order to determine the required media attributes. Possible media are then identified and appropriate ones determined by analyzing costs and production time.

This pattern holds true for many other attribute–based models, with differences based mostly on the included variables. Rumble (1986) lists the most important considerations as cost, accessibility, and results. Howard (1987) in her course design model considers learner feedback to be the prime consideration in choosing "format" (the delivery method or media used and its source). Perraton (1981) sees the decision of whether to use face– to–face teaching as the key choice. Holmberg's (1979) criteria include "the time at our disposal, the attitudes of the students, the cost, the opportunity of profitable co–ordination with practical work, and the degree of risk involved in experiments."

Wichit (1986) reports that the factors considered at Sukhothai Thammathirat Open University of Thailand are availability, accessibility, acceptability, validity (with the teaching objectives), and economics. A 1984 UNESCO report on outstanding educational materials from Indonesia lists four criteria: constraints (time, availability of equipment, etc.); combination of the objectives and characteristics of the medium; learner and teacher preferences; and costs. It also is the only model to suggest that the short– and long–term consequences of using a medium be considered. Bates (1984) lists seven factors: access, costs, student control, teacher control, organization, teacher time, and teaching objectives. Ihebuzor (1986), in an article on high–technology media selection for the Nigerian school system, lists five criteria: media attributes, costs, usability, serviceability, and availability. Berman (1980) cites only two variables that should determine the delivery: the learner's literacy in the medium and the training objective. Additionally, Freedman and Gruebel (1979) and Feasley (1983) advocate cost/benefit analysis as the single primary consideration in media selection.

Holden (1977) divides the media selection process into **software** and **hardware** selection. Beginning with degree of control (learner autonomy), he lists seven criteria for software selection: kind of learning, cost, flexibility of use, population restrictions, adaptability for other uses, and compatibility with hardware. For hardware, considerations include cost, compatibility between models, portability, life and maintenance costs. Stolovitch (1977) advocates a "do–it–yourself" approach and provides directions on preparing your own list of required attributes and media!

One issue in using this form of model of selection lies in the usual lack of direction for moving from the matrix to a decision. Some, like Holmberg (1981), Stolovitch (1977), and Leiblum (1980) use a numerical rating system of each media, while others assume the designer will somehow "balance–off" the limitations of the appropriate media.

Rieser and Gagne (1983) cite this difficulty of weighing several factors simultaneously as the rationale for using a flowchart model. They attempt to produce a "synthetic model:"

> *An appropriate approach would seem to be to identify the features incorporated in the various models, decide which features are important, and select a model containing them.*

Their first branch is a job competence decision; the designer must decide whether the consequences of task error are serious. The second branch concerns whether central broadcast will be included and further subdivides according to whether a skill, attitude, or verbal information is being taught. Visual/non–visual determinations are then made. The third and fourth major branches delineate self instruction with readers and non– readers, respectively. The final two major branches lead to media for use by an instructor with readers and with non–readers.

Another flowchart model is proposed by Anderson (1974), who distinguishes between communication for information and communication for instruction.

Smeltzer (1984) describes INSTAN, a computerized media selection program based in part on Anderson's model. Not intended to be comprehensive, INSTAN's programmer hopes it will demonstrate the feasibility of a computerized media selection model.

Note that while the flowchart format is easy to use, decision items appearing early in the process are more heavily weighted. Also, major decisions about delivery systems may have to be made before selection of individual media, reflecting an issue raised earlier in this chapter.

Finally, some authors propose "non–models." Sharples (1982) recommends five **principles** of media selection: increasing student interaction, matching the medium with the materials, reducing duplication, choosing the most direct channel, and developing user–friendly systems. Noel and Hewlett (1981) include five **heuristics** of media selection in their instructional development guidelines:

1. Beware the "not–developed–here" syndrome.
2. Select, reject, or modify?
3. Keep your eyes and your options open.
4. Examine appropriate, then available, media.
5. Get the most mileage from a medium.

Other Observations

No single model incorporates all of the features or criteria that were discussed earlier. While a few models allow and even encourage additional media that may be included, and others permit some distinction of the delivery system from the medium, none seems to adequately address the micro–macro distinction in a way that is cognizant of the varied capabilities of many newer media (for example, the personal computer). Only one model (Holden, 1977) addressed the issue of learner autonomy as a significant factor. And while one or two models mentioned the suitability of "live" teachers for certain tasks, none incorporated processes such as group interaction or personal reflection as media or a delivery system.

Very few of the models (Holden, 1977; Rieser and Gagne, 1983) have been field tested and the results reported. And other than the model reported by UNESCO (1984), there was almost no consideration given to consequences of using a particular medium. Perhaps a technology assessment is presumed to happen in the total ISD model, but it seems unusual that media selection models do not mention it!

Perhaps many of these issues result from the way we conceptualize instructional development. Many instructional system developers seem to presume that they are creating closed, self–contained systems. Their systems are viewed as ends in themselves, not as means to an end: learning. Also, while a few models (Rieser & Gagne, 1983, and others) include media for accomplishing attitudinal objectives, a primary focus is cognitive learning. Simonson (1983) and others have shown that attitudinal outcomes require special approaches. And even in reaching cognitive objectives, Lichtenstein and Rosenfeld (1984) and Heidt (1980) indicate that there is an important relationship between the learners and the media. This may provide some grounds for challenging the separation of medium from content that most media selection models assume.

A model, or possibly separate models, are needed which will allow a designer to begin with a decision to use specific methods for delivering vocational education and to reach that conclusion. Future models should also distinguish whether they are for selection of media or delivery systems, and those for media should indicate whether they work from a prior decision about delivery systems or lead to that decision. Again, it may be possible to combine both into a single, multi–faceted model. The models must also be capable of integrating new technologies and mixes of media. Finally, they must include some rating or allow some decision concerning the autonomy given to an individual learner by the chosen medium. As these new models are developed and tested within education for employment systems, we will come to understand more clearly the nature of delivering vocational education on a regional basis and the media selection process.

Focus: The Rieser and Gagne Model

The models outlined above contain a variety of features such as how they classify media and what factors are used to categorize media. A media selection model highlighted in this section was developed

by Rieser and Gagne (1983). This model has been flowcharted into six panels with each panel representing a different instructional situation. Each panel contains a list of instructional media that may be used for that particular situation. Each of the charts in the Rieser and Gagne model forces planners to draw attention to instructional situation decisions. The six panels are titled:

1. Job competence decision
2. Central broadcast decision
3. Self instruction with readers
4. Self instruction with non–readers
5. Instructors with readers
6. Instructors with non–readers

Decisions that must be made for each part of the model should occur with curriculum planning decisions that are currently underway within EFE regions. This media selection model is best used when media requirements are considered for a clustered set of instructional objectives, all of which belong to the same domain of learning outcomes (intellectual skills, verbal knowledge, cognitive strategies, motor skills, attitudes) (Rieser & Gagne, 1983). Let's take a look at each of the panels in this media selection model.

1. The job competence decision.

The primary focus of this part of the media selection model pertains to the consequences of a student's inability to perform a certain task. The technology taskforce must try to determine the consequences of errors by the learner when he or she is first required to perform the task outside the instructional setting. This part of the model gets at the question "what is the criteria level of performance expected for this student?" If errors by the learner are considered very serious consequences, then is expected that learners will have to perform direct practice on these tasks in order to gain mastery. From an instructional technology standpoint, this means that either the real object or a highly realistic simulation may be required for the learner to gain mastery of the task. The technology taskforce might still consider other types of media which may aid the learner in other phases of instruction in addition to the actual hands–on experience.

2. Central broadcast decisions.

Within an education for employment system, there may be certain types of instruction appropriate for a broadcast system. This type of decision might be appropriate under the following types of conditions (Rieser & Gagne, 1983):

a. The learners are dispersed over a wide geographic area.

b. Transmission of the instructional content needs to be made from a central point to be received by students at scheduled times, and

c. The message is transitory, or in other words, the message does not require preserved record after transmission.

What if the instruction is designed around affective domain competencies? What if the content is to impart verbal information for recall? What if visual distinction is necessary? Will visuals help students establish mental images that may aid the recall of verbal information? These types of questions are part of the media selection model, and by addressing each, planners can help determine whether radio, television, mixed media that might include supplementary response booklets and/or other types of audio presentations might be appropriate for the type of content to be delivered.

3. Self instruction with readers.

The Rieser and Gagne model approaches the selection of media from the following four viewpoints: self instruction with readers, self instruction with non–readers, instructors with readers, and instructors with non– readers. The third chart of the model portrays media situations in which students are proficient readers and are expected to learn by self instruction. A variety of concerns should be addressed for this type of self instruction for readers. Some of these include the varying degrees of reading ability possessed by the students, the pacing needed by the students, and whether the intent of the material.

4. Self instruction for students with poor reading skills.

Additional concerns for working with poor readers pertain to feedback. For example, teaching motor skills to poor readers via self instruction methods may need to be re–evaluated with the alternative choice being instructor lead training (Rieser & Gagne, 1983).

The final two charts of the model pertain to instructor with readers and instructor with non–readers. The types of questions one must ask for

media selection if an instructor is to lead readers are as follows: Can the students, with reasonable efficiency, gain information from printed text? Will the information be an attitude or verbal type of information? Will motor practice be necessary? Will the instruction aim to influence the students' values or opinions? Is it possible that the use of visuals will help students establish images that may help them in the recall of verbal information (Rieser & Gagne, 1983)?

This model brings planners down to a bottom line for media selection: appropriate media for each instructional objective must be identified. Planners can determine to either use a single medium or a combination of media. The following procedure is one possible way to arrive at a choice (Rieser & Gagne, 1983). Try to eliminate media by crossing those off that do not appear to be logical in the situation for which the instruction is being designed. These types of questions are relevant:

a. Will you be able to produce the media by the time it is needed?

b. Is it fiscally possible to cover the cost of production, maintenance and operation?

c. Is the media that you have selected compatible with existing policies and programs?

d. Is the media that you have selected practical in its intended environment?

Summary

In this chapter we have tried to provide an overview of many approaches that may be used to select media. We have highlighted one model to provide readers with a glimpse of the types of decisions necessary to select media for instructional purposes. Media selection is a very special consideration in the revitalization of vocational education curriculum and instruction.

CHAPTER 3

From Plans to Applications: Integrating Instructional Technology Into Curricula and Instruction

Introduction

In Chapter 1, we emphasized the importance of developing a plan for instructional technology applications in your school, district, or region. Chapter 2 provides readers with information for making media selections. In Chapter 3, we focus on how to move toward thoughtful and successful integration of your plan (and the instructional technologies involved) into the fabric of your curriculum and teaching strategies. Even with an instructional technology plan in hand, integrating instructional technologies into vocational education curricula is complex. Although not a simple process, there is good reason to attempt such integration. Vocational instructors should want to integrate instructional technologies into vocational education to motivate learners, meet instructional needs of students, offer alternative methods of learning, and provide different means of assessing not only mastery of the vocational education subject, but behavioral and attitudinal outcomes as well (Tucker, 1986). A recommended way to integrate instructional technologies into education for employment is to consider instructional technology applications in the early stages of curriculum revitalization. As vocational educators draft learner objectives from worker verified task lists, they should consider a variety of educational technologies that might best serve instructional objectives.

Before discussing further the integration of the instructional technologies challenge, a few words about curriculum revitalization are in order.

Curriculum Revitalization and Instructional Technologies

The enterprise of education may be viewed as the keystone to America's future success in a global economy. Federal legislators recognize the importance of education for employment for building a

competitive workforce. They have created legislation such as the Job Training Partnership Act, the Carl Perkins Act for Vocational Education, and a welfare reform bill that might replace aid to families with dependent children program with job training, education, and work programs. Even with this effort, however, the overall report card for America's education system has featured some poor grades. A recent survey conducted by Opinion Research Corporation found 60% of the respondents blaming American school systems for inadequately preparing workers to compete. And what visions do Americans have for solving this competitive problem? Almost 80% of the respondents said improvements in American education would help a great deal (cited in "National Report," 1988).

For this nation to thrive in a competitive global economy, the enterprise of learning must become far more productive.

Consumers appear to have marginal faith in American products at this time, especially the products of American schools. The general public perceives the school system as an antiquated factory that produces shoddy products while sucking up valuable resources. This past year, for example, an Illinois manufacturing association refused to endorse a state tax increase to support education because they were displeased with the quality of high school graduates who were seeking employment with them. During the past five years, numerous reports have been issued about the condition of education, the best recognized of which described America as a nation at risk.

For this nation to thrive in a competitive global economy, the enterprise of learning must become far more productive. Instructional technologies may be used to achieve this goal. In a post–industrial based economy, education must be recognized as a strategically critical industry. Unfortunately, the productivity of the learning industry in this country has become a limiting factor for the competitiveness of the United States economy as a whole. Issues confronting schools in the 21st century will be similar to challenges faced by business and industry—increasing productivity and competitiveness. The most powerful economic purpose served by the recent trends to transform public education systems is the goal of containing costs (Perlman, 1987). Public education expenses place a tremendous burden on the national economy and on state and local governments. Containing educational costs by increasing productivity in schools offers greater economic benefits to this nation than any other espoused purpose of educational reform or transformation. The effect is to free scarce resources for other public and private investments needed for economic growth. Business investments, capital infrastructure, deficit and debt reduction, and particularly adult learning, which is so essential to economic renewal may all benefit from cost reductions in public education (Perlman, 1987).

As cited in Chapter One of this Handbook, the Illinois State Board of Education has identified three main thrusts for the education for employment initiative. Those thrusts are to improve the quality of vocational education, enhance the efficiency of vocational education, and increase access to vocational education. Each of these thrusts are meshed with the concern to increase the productivity of our programs. Vocational education curriculum that is based on performances of students lends itself to productivity and accountability measures. Competency based vocational education that is based on worker verified tasks may be improved by the strengths of instructional technologies. Education for employment systems should use a systematic curriculum model and a team of planners to insure that students' time on task with appropriate content is enhanced by effective uses of instructional technologies.

The Illinois State Board of Education has established the primary purpose of schooling as the transmission of knowledge and culture through which children learn in areas necessary to their continuing development. The State Board has recognized vocational education as a necessary delivery system for providing special learning environments and teaching techniques designed to assist individual students in their educational development. Vocational education learning environments and special teaching techniques might profitably be matched with instructional technologies for delivering the following types of vocational education programming: (a) content based on generalizable skills, transition

skills, employability skills and vocational ethics; (b) content based on the articulation of key elements of vocational education curriculum from grades 9 through 14; (c) content based on vocational education's role in helping students meet the state goals for learning; and (d) content based on worker verified task lists. Instructional materials that feature the preceding types of curriculum content, as well as state-of-the-art instructional technologies as a means for conveying it, represent powerful means for insuring that students reach their goals in education for employment programs.

High-grade instructional materials remain the hallmark of quality vocational education programming. The following section of this chapter will acquaint you with curricular concerns that should be addressed in an instructional technology plan.

Information Technologies: Potential Effects on Curriculum

If one assumes that information technologies will be more widely and generally available in schools in the future, what type of impact might those technologies have on education for employment programs? Gibbon (1987) foresees three kinds of changes in curriculum brought about by information technologies: (a) **Additions** to the curriculum, that is, teaching about the information technologies themselves; (b) changes in the **content** of the curriculum based on these technologies; and (c) changes in the **structure** of curriculum and the manner in which it is delivered in the classroom.

New skills for vocational students may be required— those of comprehending, analyzing, evaluating, and producing communications through electronic media.

The major curricula addition may pertain to an emphasis on **information** itself. Vocational education students will need to examine numerous types of information and recognize characteristics of these data. In addition, students will need to recognize sources of data, evaluate the quality of data, and use numerous means for communicating with data sources and other parties. New skills for vocational students may be required— those of comprehending, analyzing, evaluating and producing communications through electronic media (Gibbon, 1987).

Electronic technologies of the information age may increase the degree of multidisciplinary teaching across vocational education disciplines.

The teaching of basic skills has become an important segment of vocational education curriculum and instruction. Other important skills are employability skills. Instructional technologies may affect curriculum content for basic and employability skills because of huge volumes of information that students will need to read, comprehend, analyze, and process. Vocational education students will need to effectively and efficiently skim through text delivered by electronic media. They will learn the means for using indices, menus, section headings, topic sentences, and summaries, and for conducting visual scans for key words by skimming and using browsing skills (Gibbon, 1987). Vocational education students will need to recognize media passages that deserve close attention as opposed to those in which a broad survey and quick glance will be more appropriate. In other words, the capacity to access, search, and manipulate information from multiple sources may be increasingly important in the future. Skills involving data handling may be considered **basic**.

Electronic technologies of the information age may increase the degree of multidisciplinary teaching across vocational education disciplines. There are several ways that information technologies may accomplish this (Gibbon, 1987). First, vocational topics can be given a very vivid presentation with instructional technologies, such as computer simulations and expert system software packages. These types of electronic media are able to provide experiences for people covering places and subjects

that might otherwise be inaccessible to students because of cost, time, safety, or other reasons. Second, an in–depth look at the topic may be explored through the use of computer data bases, video disc and compact disc archives, computer based expert systems, telecommunications networks, and computer analytic tools.

Third, once students have explored a vocational education topic, they may share their learning activities with other students and teachers across the state via a combination of reporting media. Such media might include reports written, illustrated, composed, printed, and transported using computers; video documents composed of footage assembled and edited from archival material or created by students on tape; audio reports that might include long distance telephone interviews with experts; and computer analyses that were created by students using software or programs especially created for that project.

Such planning and reporting via multimedia offer several appealing features to vocational education students: (a) These types of approaches to learning make learning fun. Student authors will increase their mastery of the subject matter, (b) other students will pay more attention to the work and instruction of their peer students, and (c) young authors will increase their understanding of and skills in using different types of media.

The concept of synergy is perhaps the best way to describe the team effort needed to plan for instructional technologies in education for employment.

Vocational education already has existing examples of successful projects that use a multidisciplinary approach to teaching vocational education. For example, some districts use the project of building a house through the multidisciplinary subjects of vocational education. Drafting students design the floor plan, horticulture students landscape the grounds, interior design students select furnishings for the interior, distributive education students market the house, and building trades students perform a variety of tasks to construct the house. Future vocational education programs will use electronic media to involve different disciplines of vocational and academic education to work on an increased number of multidisciplinary projects that simulate the real interactions of business and industry. A common thread to those interactions will be the power of information technologies.

Moving the Instructional Technology Plan Into Action

Given the existence of an on–going curriculum revitalization process and of a plan of some form for technology applications, and given the character of emerging information technologies, how might a school district or region integrate their technology plan into the curriculum building process in a way that will facilitate a teacher's use of instructional technologies? There is clearly no single formula to accomplish the task. We suggest, as one approach, that a school or district consider creating a team to pursue the integration task.

Teamwork is the name of the game for planning, implementing and evaluating uses of information technologies in education for employment. Several individuals with special interests and talents are needed within an EFE system to consider new developments with information technologies and how they might be applied to meet instructional needs. The concept of synergy is perhaps the best way to describe the team effort needed to plan for instructional technologies in education for employment. Synergy is the belief that the behavior of a group of individuals is different from the behavior of the individual components that make up that whole. In other words, the sum is greater than merely adding together the individual parts. When put to use by a creative instructor or motivated student, information technologies may result in a better learning environment than what might occur without them (Kearsley, 1984). With the concept of synergy, increased efficiency and productivity in the classroom may be the result of the human abilities of teachers and students multiplied by the capabilities of the specific technologies. Stated another way, if a course is taught on the basis of sound instructional design principles with creative uses of instructional media, learning strategies and

competency based curricula, then student performances should improve from a traditional, straight lecture teaching format. Getting to this point is the charge of the technology group.

A **taskforce for technology planning** is one means for reviewing practical considerations that impact the feasibility of integrating information technologies into vocational education. This task force might begin with activities such as developing an inventory of existing instructional technology capabilities among member local educational agencies. In conducting this activity, the task force should consider (Kearsley, 1984): (a)the viewing and/or hearing range of existing delivery equipment, (b) the availability of necessary equipment and facilities within the education for employment system, (c) the availability of personnel with skills that are needed to develop, implement, and revise programs that incorporate information technologies, (d) the usability and dependability of equipment for accomplishing instructional objectives, and (e) the flexibility of existing media in meeting a broad range of instructional needs throughout the education for employment system.

More specifically, the taskforce for technology planning might work through the following types of activities as suggested by Kearsley (1984):

1. Starting with worker verified task lists, identify possible instructional technologies that may be used for each task.
2. Delete media that are inappropriate based on student or learning environment characteristics.
3. Prioritize instructional technologies based on practical, economic instructional, and administrative factors.
4. Select instructional media for worker tasks that have received highest priority rankings.
5. Consider combining instructional technologies for clusters of related job tasks that may be taught in a combined setting.

Creating a plan for information technologies in education for employment and then moving the plan to action will be a tremendous challenge. It is always tough to break new ground with an innovation. Continual changes in technologies may make it difficult to create and implement a plan. As a guiding light on this topic, a successful endeavor for creating and implementing such a plan should include five steps (Dively, 1987).

1. Identify current needs and uses.

Once again, the undergirding factor for any successful infusion of technologies into an education for employment system will be a comprehensive look at educational needs. Data may be gathered from students, teachers, and administrators regarding educational needs. In addition, information may be gathered about existing uses of instructional technologies both locally and across the state. Consideration must be given to the projected educational needs of the EFE system as well as the potential for information technologies at meeting those needs.

2. Collect recommendations from interested parties.

Seek advise from parents, teachers and administrators who have interests in how information technologies may help the EFE system reach its goals. Broad involvement helps identify problems, issues or needs that may be overlooked by small planning teams.

3. Review activities underway by other schools, districts, EFE systems, states, and countries.

We can learn a lot from the experiences of other schools when it comes to instructional technology applications. Informal discussions with planners from other EFE systems may help you avoid costly mistakes they may have experienced. Vocational educators should visit sites where information technologies are already in place and are meeting similar educational needs. In addition, avenues may be created for cooperative ventures with select types of information technologies.

4. Educate key educational leaders.

Local decision makers should be made aware of the uses, importance, and future developments for information technologies. In many states, the successful implementation of information technologies has been the result of committed top officials who have believed in the potential for success of a given technology and vigorously supported its development.

5. Develop policy.

Once data has been collected and a base of support has been carefully orchestrated, a clear set of policies must be created to guide the integration of information technologies into curriculum and in-

struction. The policies should be based on the educational needs and instructional problems of the EFE system and should reflect the nature of change that is characteristic of information technologies (Dively, 1987).

Often the best results are achieved when instructional technologies are combined for synergetic results as opposed to when they are used as lone entities to solve instructional problems.

A taskforce for instructional technology planning and implementation for vocational education can assist a school, district, or region to reach peak levels of learning using technology applications. This team of individuals must realize that selecting technologies for instructional purposes is analogous to an adult version of the building blocks of Lego for children. The great thing about Lego, of course, is that those little blocks have infinite possibilities for creating nifty structures. The same may be true of instructional technologies. Often the best results are achieved when instructional technologies are combined for synergetic results as opposed to when they are used as lone entities to solve instructional problems.

This taskforce should not merely match worker verified task lists with appropriate instructional technologies and turn the process over to instructors. Every instructional technology features different capabilities for meeting instructional needs. More importantly, each technology requires a unique ability by the instructor to use it most effectively (Kearsley, 1984). Almost any media may be effectively used to teach the tasks associated with vocational education if the instructor is well versed in the capabilities of that technology and has the creative insights to apply it toward its best use. Media selection is important, as was pointed out in Chapter 2, but so is how instructional technologies are used by vocational teachers. A taskforce on technology for vocational education should spend ample time and energy creating recommendations for teachers on how best to apply a given technology in the classroom. These types of descriptions will help teachers not only select appropriate technologies, but also understand how these technologies may best be to teach content associated with worker verified task lists. The application of instructional technologies in vocational education will be successful when appropriate content is identified from worker verified task lists, objectives and criterion referenced tests are devised, and teachers understand the full range of capabilities of instructional technologies at delivering and evaluating the course content (Kearsley, 1984).

Instructional technologies should lead to improvements in vocational students' learning, mastery, and competence so they may be better able to seek employment and/or further education and training upon graduation. This Handbook is a team approach for determining how to communicate subject matter content in vocational education courses using the most powerful methods to enhance learning in the classrooms. The term instructional technology suggests that a variety of tools, methods, knowledges, and understandings are available for instructors to use in designing and delivering vocational education instruction. This variety of choices requires many decisions (Kaufman & Thiagarajan, 1987):

1. Where will the instruction be delivered within the EFE system?
2. What tools and techniques are available within the system?
3. When will we use them?
4. How will we design and deliver learning experiences appropriate for the instruction?
5. Which students will get what content and methods?
6. Where is the best place within the EFE system to deliver the instruction?
7. How do we determine if our results are adequate?
8. What do we revise if our results are less than expected?

Each of these questions is important, and must be addressed as attempts are made to plan for technology applications. Another set of decisions is equally important for instructional technology planners. Not only must planners decide upon appropriate instructional technologies, they must also identify professional development needs of personnel who are involved with instructional technology applications. The following chapter of this handbook is a compilation of issues and ideas regarding staff

development as a component of an instructional technology plan.

CHAPTER 4

Integrating Instructional Technologies into Vocational Education: Staff Development Issues*

The information technologies revolution we have been discussing in this Handbook, characterized by rapid developments and reduced costs in electronic information technologies and global information networks, can impact all vocational disciplines. This evolution has been accelerated by the introduction of low–cost technology that may serve vocational programs throughout the nation. This situation is fueled by beliefs that applications of contemporary instructional technologies will decrease the cost and increase the effectiveness of education and training. The epitome of this spiraling concern for technology was reinforced when Time magazine selected the computer as the "Man of the Year" in 1984 (Hart, 1987).

Technology can be used to enhance students' abilities related to reading, writing, arithmetic, speaking, and listening skills. These basics of education, which are concerned with accessing and processing information, can be improved through instruction in vocational education as students are shown how automated technology is applied in business and industry (Moursund, 1986). Furthermore, as instructional technologies are used as teaching mediums, as well as specific objects of study, students in vocational education will be better prepared for a multitude of new careers in technology (Nasman, 1982; Office of Technology Assessment, 1982).

These types of applications go beyond merely automating clerical processes. The profound changes in schools made possible by information technologies will place new demands on teachers and learners. This in turn means that teaching and administration staff may need to develop new skills and attitudes and learn new information so they can perform their jobs more effectively. Staff develop-

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ment is extremely critical to successful technology applications. Before considering staff development approaches, we examine some of the factors contributing to the need for staff development efforts.

The Instructional Technology Movement Could Be Increasing by an Order–of– Magnitude

Contemporary instructional technology has the potential to significantly affect vocational education as it is known today. Judd (1983) refers to its potential as the order–of–magnitude training effect. For example, he describes a computerized videodisc system that reduced the training time necessary to teach cardiopulmonary resuscitation from more than 100 minutes to 10 minutes or less. History has demonstrated that order–of–magnitude changes have an impact far beyond the particular field in which they occur. For example, the invention of the automobile not only meant that individuals could travel 30 miles an hour instead of three, but it created suburbs, increased our society's overall mobility, and provided teenagers with a new independence. Similarly, Gutenberg's invention of the printing press not only made the reproduction of books 10 times faster, but it made learning available to the masses. Suddenly anyone who could read was able to acquire knowledge which had previously been held only by priests and scholars.

Although giant mainframe computers have had significant computational power for nearly three decades, only when microprocessors became widely available could their influence on everyday life become pervasive.

Order–of–magnitude technological changes modify the entire context in which that technology is embedded. Judd (1983) indicates that the personal computer has led education to the threshold of an order–of–magnitude change. His justification for this belief is that new computer technology in the form of microcomputers has been made available at the individual level. He uses the analogy that trains had traveled 50 to 60 miles per hour long before automobiles, but not until the advent of the motorcar could individuals take advantage of the increased speed of transportation. Likewise, although giant mainframe computers have had significant computational power for nearly three decades, only when microprocessors became widely available could their influence on everyday life become pervasive.

If instructional technology is going to have the significant order–of–magnitude effect on education and learning that Judd (1983) suggests, then it is imperative for vocational educators to integrate these new technologies into their programs. In order for this vast movement to be accomplished, vocational instructors will have to be highly motivated and they will have to increase their personal knowledge, skills, and attitudes about instructional technologies. A primary concern that could be a major hurdle to overcome in applying contemporary technology in our programs is technological anxiety.

Technological/Computer Anxiety

Vocational educators throughout the United States are concerned with the overall issue of using new technologies to deliver instructional programs to their students. This process often requires vocational instructors to participate in staff development on the uses of instructional technology in order to implement applications in their classrooms. As adult learners, they often experience anxiety and frustration during the process of learning (Honeyman & White, 1987). Some educators are developing an attitudinal problem which may be referred to as computerphobia (Widmer & Parker, 1983–84, Winter). The fear of computers, also referred to as cyberphobia, is an affliction affecting millions of Americans (Norris & Lumsden, 1984, January).

Remember the term "anxiety reactions" discussed by Toffler (1970) in *Future Shock*? He indicated that this physical and/or mental reaction is the result of adapting to constant change. This dilemma, whether real or imagined, is caused by the speed with which these changes are occurring. The situation, change,

is compounded when individuals do not have any choice as to whether or not they want to change. Weinberg (1982, August) attributes the fear of computers to individual feelings of lost control and predicts a worsening of the situation as society becomes increasingly computerized. Technological advances within the computer industry have been swifter than our ability to comprehend and integrate them into our educational systems (Friedman, 1982, November–December). Powers (1983) reports that a feeling of uncertainty underlies the phenomena of computer anxiety. This uncertainty can refer to one's ability to learn to use new technologies or to the potential these machines have to rearrange traditional work functions and power structures.

As school boards and superintendents insist that technology be used to instruct students, teachers and administrators are often compelled to learn about technology as quickly as possible. This can create a situation where teachers have higher levels of anxiety regarding the use of technology than do students (Cambre & Cook, 1984), which often interferes with a classroom teacher's ability to teach (Mauer, 1983).

Resolving Technological Anxiety

Research has demonstrated that anxiety levels can be reduced when individuals are allowed to work with technology over a period of time (Gilroy & Desai, 1986). Consequently, educators should be cautious about using short–term inservice staff development activities which allow minimal technology contact when working with beginners. Teachers must be given time to learn the appropriate uses of instructional technology (Honeyman & White, 1987). Numerous studies have demonstrated that staff development related to design, selection, and use of instructional technology improves educators' attitudes toward that technology. These positive effects appear to be the same whether the training is in graduate school or an inservice staff development activity (Day & Scholl, 1987).

Defining Staff/Professional Development

Professional development and staff development are similar processes with regard to their primary goal of providing learning or growth opportunities to involved participants. Both types of development must be based upon **predetermined needs** and a **systematic approach** to the intended growth areas.

Staff development is often viewed as a collection of activities that facilitate the advancement of knowledge, skills, and understanding of teachers in ways that lead to changes in their thinking and classroom behavior (Fernstermacher & Berliner, 1983; Sparks, 1984). It is adult education (Southworth, 1984) that must draw from research on teaching effectiveness and instructional technology in order to make a difference in the schools (Vaughan, 1983; Wideen, 1987). Staff development must be a systematic attempt to bring about change toward an articulated end (Smylie, 1988). As B.D. Peterson states:

> *Staff development is a process designed to foster personal and professional growth for individuals within a respectful, supportive, positive organizational climate having as its ultimate aim better learning for students and continuous, responsible self–renewal for educators and schools (Peterson, 1981).*

If powerful training options are to be implemented, vocational teachers must become trainers of one another.

The overall professional or staff development process must involve vocational teachers and administrators as students of teaching in a public, cumulative fashion. Regardless of the competence of these professionals, they need to continually study their profession. They must seek new options, polish and, develop their skills, rethink their curricula, and make the learning environments of schools more powerful (Joyce & Well, 1980). The most effective professional or staff development ac-

tivities combine theory, modeling, practice, feedback, and coaching to application (Joyce & Showers, 1980). If powerful training options are to be implemented, vocational teachers must become trainers of one another. Vocational educators must assist each other in learning to study theory, to demonstrate, to organize and practice, to give feedback, and, of critical importance, to coach one another in the classroom. Vocational teachers' abilities to coach each other are vital to the overall productivity of any professional or staff development system (Joyce, 1981). In a recent investigation, Smylie (1988) found that teacher change is rooted in individual perceptions of self as influenced by experiences within classrooms and with teaching colleagues.

Overview of Self–Directed Development

Self–directed development is a process by which vocational teachers can systematically plan for their own professional growth (Glatthorn, 1984). Through the use of an individualized Professional Development Plan (PDP), vocational educators can conscientiously implement their personal plan over a predetermined period of time. This approach to professional or staff development works most effectively with vocational instructors who are experienced and competent teachers, skilled in self–analysis and self–direction, and who enjoy working alone or with colleagues. The value of self–directed development is that it appears to increase teachers' insight about and ability to achieve professional growth. Ideally, vocational teachers will discuss their PDPs with some other professional, such as a colleague, department chairperson, or principal, after it has been written. Ultimately, the successful use of a PDP will rest upon the creation of meaningful and achievable goals and objectives. Vocational teachers' goals may or may not be directly related to the goals of their program or local educational agency (LEA). It should be noted that a written plan will probably facilitate self–directed growth.

Self–directed development is a process of professional growth characterized by the following four features:

1. The individual works independently on a program of professional growth...
2. The individual develops and follows a goal–oriented program of professional improvement...
3. The individual has access to a variety of resources in working toward those goals...
4. The results of the self–directed program are not used in evaluating teacher performance (Glatthorn, 1984).

Advocates of the self–directed development model primarily base their argument on the individualized needs of teachers, the nature of adult education, and the professionalism of teaching. Similar to other educators, vocational teachers have distinct individualized needs and learning styles. If vocational instructors prefer organized and systematic staff development programs, then they must identify workshops or courses that are available and include them as activities in their PDP.

Educators need a modern, realistic awareness of the current and potential capabilities of instructional technology as well as the limitations.

Some principles for facilitating adult learning are generally accepted regardless of one's stage of development. These principles have broad–based endorsement and some empirical support (Bents & Howey, 1981). According to Knowles (1978), these five principles constitute "the foundation stones of modern adult learning theory:"

1. Adults are motivated to learn as they experience needs and interests that learning will satisfy; therefore, these needs and interests are appropriate starting points for organizing adult learning activities.
2. Adult orientation to learning is life–centered; therefore, the appropriate units for organizing adult learning are life situations, not subjects.
3. Experience is the richest resource for adult learning; therefore, the core methodology of adult education is the analysis of experience.
4. Adults have a deep need to be self–directing; therefore, the role of the teacher is to engage in a process of mutual inquiry rather than to transmit knowledge and evaluate conformity to it.

5. Individual differences among people increase with age; therefore, adult education must make optimal provision for differences in style, time, place, and pace of learning.

The key to success is professionalism: Each vocational educator must accept the responsibility for applying instructional technology in his or her program.

Vocational teachers vary in the degree to which they can and want to participate in self–directedness, in their ability and desire to work collaboratively, and in their competence to deal with conceptual problems and universal principles as well as practical concerns. These differences are often related to developmental stages. Teachers need to possess a clear understanding of others' expectations of their role. The adoption of a simple system which assists vocational educators in understanding what it is that they are expected to learn and do can increase their self–awareness and role–awareness. This understanding is necessary in order to grow professionally. Therefore, professional development in the form of adult learning must take into account the **professional performance** of teachers and **how this performance is determined** by such factors as personal goals, strengths, needs, and beliefs (Bents & Howey, 1981).

The need for vocational educators to be involved with a Professional Development Plan has been called for by David Moursund, editor–in–chief of The Computing Teacher. Moursund (1983) indicates that educators need a modern, realistic awareness of the current and potential capabilities of instructional technology as well as the limitations. This awareness can be acquired through reading, hands–on experiences, talking to others, thinking about instructional technologies, and attending conferences and workshops. But what follows after vocational educators have achieved technology awareness? Moursund (1983) believes that educators must make a new commitment to their students and themselves through an Individual Technology Literacy Education Plan (ITLEP).

The concept of the ITLEP is relatively simple. It requires each educator to assume the responsibility for his or her own technology–in–education literacy by developing a plan to acquire a professional level of instructional technology competency. Moursund states that each instructor is the most qualified person to determine his or her specific professional and programmatic needs for technological literacy, knowledge, and skills. Although outside assistance may be desirable in gaining initial technological awareness, an ITLEP aids the educator in focusing on general technology literacy and specific needs associated with that educator's professional responsibilities. The latter will certainly change along with state–of–the–art instructional technology. Furthermore, the ITLEP may include short–term goals, long–term goals, specific objectives, and methods of measuring progress toward these objectives. In addition, each plan must have a timeline which permits individuals to review their progress on goals and objectives. As Moursund implies, the key to success is professionalism: Each vocational educator must accept the responsibility for applying instructional technology in his or her program. This powerful idea has the potential to dramatically improve vocational education programs (Tesolowski, Wallin, Roth & Rankin, 1984).

Developing an Effective Professional or Staff Development Program

Traditionally, educators have had negative attitudes toward inservice staff development activities. Studies conducted at state and national levels during the past 15 years have consistently suggested that the majority of teachers, administrators, and college personnel are not satisfied with staff development programs (Arnsworth, 1976; Brimm & Tollett, 1974; Zigarmi, Betz, & Jensen, 1977).

Problems that have been identified related to inservice programs include: poor planning and organization; lack of participant involvement in the planning and implementation of the inservice; utilization of activities that are impersonal and unrelated to the day–to–day problems of participants; inadequate

needs assessment: unclear objectives; and the lack of follow–up in the classroom or job setting after training has been concluded. When these problems are coupled with what is known about adult learning and motivation, and in light of the general anxiety many educators feel about technologies, it becomes apparent that inservice educators and trainers could benefit from a set of guidelines. Wood and Thompson (1980) suggest the following six recommendations:

1. Include more participant control over the "what" and "how" of learning;
2. Focus on job related tasks that the participants consider realistic and important;
3. Provide choices and alternatives that accommodate differences among participants;
4. Include opportunities for participants in inservice training to practice what they are to learn in simulated and real work settings as part of their training;
5. Encourage learners to work in small groups and to learn from each other; and
6. Reduce the use and threat of external judgments from a superior by allowing peer–participants to give each other feedback concerning performance and areas of needed improvement.

A synthesis of research on staff development tends to support these six recommendations. The ERIC Clearinghouse on Educational Management (1980) summarizes that effective staff development programs:

- are concrete and aimed at specific skills
- emphasize demonstrations and opportunities for staff to practice the new skills and receive feedback
- are individualized to address the requirements of each participant and to relate to on–the–job needs
- are ongoing, stretching throughout the school year
- are held at school rather than elsewhere
- include opportunities to observe other teachers who have mastered and are practicing the skills being taught.

As vocational educators begin to think about creating their own Professional Development Plan related to technology applications, it would be helpful for them to reflect upon the recommendations and summary of research that have been presented. Vocational teachers should develop their own PDPs with the same intensity that they would exhibit while preparing a course for their vocational programs. Some additional suggestions that might be of assistance in completing a PDP include:

1. Conduct a needs assessment in order to focus the plan. Remember the importance of not trying to do too much.
2. Set specific, practical objectives for the plan.
3. Consult with other individuals who have expertise related to instructional technology. Do not allow anyone else to dictate what should be included in a plan.
4. Work on the plan as well as its implementation at convenient times.
5. Build a variety of learning opportunities into the plan. Be sure to include many hands–on experiences.
6. Include at least one immediately useful technological application in the plan.
7. Plan to spend at least one day, as soon as possible, becoming acquainted with some new aspect of instructional technology.
8. Build some type of a follow–up system into the plan ("Home–Grown Computer Instruction Deemed Best," 1984, June 6).

Developing a Professional Development Plan

The preparation of successful developmental activities must be based upon predetermined needs. Three forms of needs assessments are commonly used:

1. Individuals in supervisory positions determine needs from their assessment of the quality of work being performed by people who work under their supervision.
2. Persons are asked to state their own perceived needs or to respond to a rating instrument or checklist.
3. Groups of professionals from schools, divisions, departments, or teams respond to various external or internal pressures by planning collaboratively to create specific changes (Peterson, 1981).

Within a local educational agency (LEA), all three processes may operate simultaneously.

Professionals in the field of vocational education must be concerned with self–assessment or the in-

dividualized approach to planning, developing, and implementing professional growth activities (Roth, Tesolowski, Rankin, & Blackman, 1984). The greatest advantage of this approach toward professional or staff development is that it permits almost complete autonomy on the part of those for whom the developmental activities are intended (Peterson, 1981).

Professionally developed materials can be utilized to facilitate professional growth on the part of vocational educators. These materials can be used to individualize professional development regardless of whether these learning activities are formal or informal. Research has demonstrated that individualized staff development activities tend to be more effective than those that present uniform experiences to all participants (Lawrence, 1974), and that teachers can learn from self–instructional materials as well as from trainers or course instructors (Edwards, 1975; Glatthorn, 1984; Kulik, Kulik, & Cohen, 1980).

Constructing and Implementing a PDP

A properly developed Professional Development Plan can serve as the critical link between vocational teachers and the appropriate application of instructional technology in their programs. The PDP should serve as a management tool. Essentially, the plan should permit any vocational educator to determine and understand what it is that he or she really wants to know about and do with a selected type of instructional technology. The process of constructing and implementing a PDP should assist vocational educators in:

1. Acquiring responsibility for their own learning,
2. Developing a positive attitude toward learning about instructional technology through success oriented activities,
3. Being active learners, rather than passive learners, and
4. Experiencing learning activities that are consistent with their own individual needs, interests, and abilities (Bishop, 1976).

Components of the PDP

The Professional Development Plan can help vocational educators learn more about instructional technologies. A PDP can assist vocational teachers in expanding their personal level of technological awareness. Furthermore, it can be used to increase applications of instructional technologies in vocational programs.

Components that must be addressed in an individualized PDP include:

1. A review of each vocational educator's personal level of performance and knowledge related to instructional technology or the application of these technologies in his or her program;
2. A statement of long–range goals based on identified strengths and weaknesses from a self–assessment of one's knowledge of, skills related to, and attitude toward contemporary instructional technologies;
3. A statement of short–term objectives that evolve from the needs created by the identified long–range goals;
4. A statement of strategies, methods, or techniques that can be utilized to accomplish the short–term objectives;
5. A statement of materials and resources that can be used to facilitate the accomplishment of short–term objectives through the identified strategies, methods, or techniques;
6. A statement of the date on which any activities related to a specific short–term objective have been initiated;
7. A statement of the date on which all activities related to a specific short–term objective have been terminated; and
8. A statement that indicates whether or not a specific short–term objective has been mastered.

These eight components comprise the integral parts of the Professional Development Plan. Successful use of the PDP hinges upon an honest self–appraisal and the ultimate establishment of important and realistic long– range goals and short–term objectives.

The Key to Implementing Successful Staff Development Activities

Ownership may be one of the most critical elements when it comes to using staff development activities to integrate instructional technologies into vocational education programs. This concept relates

to both personal ownership of the individual training process and administrative/management ownership of the overall outcome (Armstrong & McElhone, 1987).

Developers of staff development activities have the responsibility for creating optimal learning situations.

Administrative Ownership

The most important ingredient in an educational setting is administrative support. Administrators must be convinced that the short–term cost of staff development in time and money will be repaid many times over in long–term gains in productivity and effective educational practices.

Educational administrators must understand that the success of staff development activities may depend upon these concepts:

1. Educating people about instructional technology requires a great deal of concentration. Therefore, an adequate schedule of uninterrupted training time must be made available.
2. The actual training process is truly the beginning; a great deal of practice is necessary in order to complete the process. Administrators must realize that program completers will not be fully competent until they have had adequate practice.
3. Successful outcomes are directly related to motivation, and motivation is often directly related to the degree of administrative support perceived by vocational instructors.

Personal Ownership

As part of the staff development process, vocational teachers must take and be given ownership of their own training. Based on adult learning theory, it has been established that vocational educators must visualize a concrete benefit to themselves for assimilating new knowledge. Since adults usually learn what they perceive they need to know, the task for trainers in staff development activities is to make the positive benefits clear (Armstrong & McElhone, 1987).

Suggestions for Selecting Staff Development Activities Related to Instructional Technology

Staff development activities may be conducted in a few hours or they may last as long as several weeks. These activities may be provided by numerous sources such as independent consultants from professional associations, community colleges, universities, or private vendors. To determine whether or not a particular program meets your staff development needs the following issues could be considered:

1. Is literature available that describes the activity? Does the literature include specific learning objectives or vague goals?
2. Are objectives expressed clearly in performance or behavioral terms?
3. Are expected behaviors described in observable and measurable terms? Do they seem realistic and reasonable given the time constraints?
4. Is the content of the activity appropriate for professionals from your vocational discipline? Does the literature recommend certain levels of experience or particular background?
5. Does the literature provide an outline of the topic and subject matter to be covered in the activity?
6. Does the literature include a time schedule with time allotted for participants to discuss issues and ask questions?
7. Does the schedule include time for participants to think of ways to apply the content of the activity in their vocational programs and to discuss these ideas?
8. Does the schedule permit time for feedback? Are participants able to inform leaders of the activity about whether or not their training needs are being met during the program?
9. What type of instructional methods will be used during the activity? Are these methodologies explained in the literature?
10. Are the instructional methods participative and action–oriented? Will participants be expected to get involved or will they simply sit and listen?

11. Does the description of the activity mention opportunities for participants to consult with program leaders either in small groups or one–on–one?

12. Can you obtain information about the designers and leaders of the activity? Have they published respected materials on topics covered in the activity? What credentials do they have?

13. Do the leaders of the activity have only corporate, bureaucratic, or academic backgrounds?

Investigate the sponsoring organization to determine if its past programs have met with success and its previous participants are satisfied with the results of the activity. Review the following issues with regards to this concern:

14. Is the activity being sponsored by an established organization that has been in operation for two or more years? (Reputable new organizations should not be dismissed, however, it is easier to obtain information on older organizations.)

15. Does the organization have at least one year of experience conducting programs on topics of interest and benefit to you?

16. Have the leaders of this activity worked for this sponsor for more than one year? Do they offer programs similar to this activity in other locations?

If the activity has been offered before, get rosters from the organizations and contact former participants for recommendations and opinions. Find out how previous participants are currently applying the training. This may be more important than finding out whether or not they liked the experience. To learn more about the usefulness and quality of the activity, ask previous participants the following kinds of questions:

17. Have previous participants instituted new procedures in their vocational programs?

18. What instructional practices have previous participants changed as a result of the activity?

19. What problems have they solved as a result of attending the activity?

20. Have previous participants' schools realized any positive outcomes from investing in this training?

21. Did participants fit the advertised description of who should attend or did the leaders accept anyone who paid the fee?

22. Is preparation necessary for this activity? How should participants prepare?

23. Does this activity provide for individualized instruction and attention from the leaders?

Summary

Information technologies hold many promises for teaching and learning processes in the future. Future projections are that we will continue to see technological innovations that are more powerful, faster, user friendly, and even cheaper than technologies currently on the market. These technologies may very well alter the way we view situations, solve problems, and interact with one another. They hold the promise for a poverty stricken, ten–year–old child in rural Appalachia to have access to a complete, unabridged version of the Encyclopedia Britanica at the touch of the keyboard on a school's personal computer. They hold the promise for a high school journalist to skim over current editorials from high school papers from across the country that are shared on an electronic billboard. They hold the promise for an automotive student at an area vocational center learning to diagnose engine malfunctions with an expert system. They hold the promise for a student from a school of only 150 students to receive advanced instruction in calculus from a teacher many miles away via a two–way interactive television system. They hold the promise for a physicist from the Fermi Lab to deliver a lecture via satellite to students across the state in principles of technologies classes. They hold the promise for students to receive individualized instruction via integrated learning systems so they may master basic skills required for high school graduation. They hold the promise for vocational students to use a desktop publishing system to create troubleshooting fact sheets for maintaining and repairing microprocessors. And for all academic disciplines, they hold the promise of altering the way we view teaching and learning situations, how we present these situations to students, and how students attempt to rectify these situations or solve problems. In summary, information technologies represent new ways for conducting mental operations in classrooms.

Will these promises be realized? The last chapter of this handbook emphasized the importance of preparing personnel for information technologies. Although it is important that each school district and/or education for employment system creates a plan for integrating information technologies into curriculum and instruction, it is also imperative that each instructor develops and implements an in-

dividualized plan for technology literacy in teaching and learning. The focus of this handbook is to show that information technologies do, in fact, hold great promise for teaching and learning in the classroom. Fulfillment of that promise hinges upon well trained professionals and their applications of these technologies to meet the crucial instructional needs of learners in classrooms.

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